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Computer tomography 3-D imaging of the metal deformation flow path in friction stir welding

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In friction stir welding, a rotating threaded pin tool is inserted into a weld seam and literally stirs the edges of the seam together. This solid-state technique has been successfully used in the joining of materials that are difficult to fusion weld such as aluminum alloys. To determine optimal processing parameters for producing a defect free weld, a better understanding of the resulting metal deformation flow path is required.

Marker studies are the principal method of studying the metal deformation flow path around the FSW pin tool. In our study, we have used computed tomography (CT) scans to reveal the flow pattern of a lead wire embedded in a FSW weld seam. At the welding temperature of aluminum, the lead becomes molten and thus tracks the aluminum deformation flow paths in a unique 3-dimensional manner. CT scanning is a convenient and comprehensive way of collecting and displaying tracer data. It marks an advance over previous more tedious and ambiguous radiographic/metallographic data collection methods.